

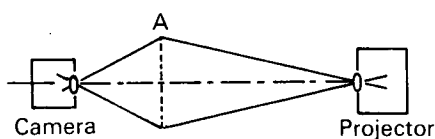


AEC-NASA TECH BRIEF

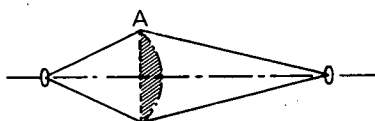


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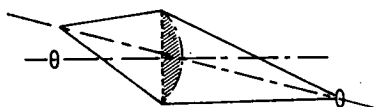
Aerial-Image Enables Diagrams and Animation to Be Inserted in Motion Pictures



Camera-Projector System

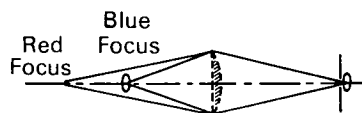


Field Lens System
Aerial Image Optics

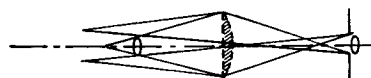


System misaligned; camera
does not "see" projector lens.

Aerial Image Unit



Small Aperture (image will appear blue).



Chromatic aberration; large aperture
(camera does not "see" color fringe).

The problem:

In technical motion picture production it is often desirable to show the internal construction of complicated machinery, or to insert diagrams and animation into live pictures. It is also sometimes helpful if the general details of a picture can be suppressed, thus making it possible to outline or "lift" an element from a confusing background.

The solution:

An aerial-image unit that makes it possible to insert diagrams and animation into live pictures, and also lift an element from a confusing background by suppressing general details. The unit consists of a projector which throws an image on the field lens located in the bed of an animation stand. This lens

deflects the light to a camera. Thus cel material (artwork prepared on transparent sheets of film) laid over the field lens masks the image and is photographed together with the projected picture. High-quality camera and projector lenses and critical alignment of the system are essential to make an effective system.

How it's done:

The aerial-image unit includes a combination of two separate lens systems, the camera-projector system and the field lens system. The projector focuses a real image at a point A (the field lens) which is rephotographed by the camera. The projection and camera lenses must operate near maximum aperture, so very high quality lenses are required to avoid loss of definition. The field lens deflects the light toward the

(continued overleaf)

camera; it throws the image of the projection lens upon the taking lens. Critical alignment is essential, for if the image does not fall directly on the camera lens, the camera will not "see" the picture.

The field lens need not be high quality glass, but it must be free from bubbles or small flaws; otherwise these will be photographed as part of the final image. The field lens, ground from two pieces of 1-in. plate window glass, should be designed for the least amount of spherical aberration with the top surface lying flat. Spherical aberration is minimized when the angle of refraction is equal at all surfaces; therefore, when the field lens is farther from the projector than the camera, it should be designed as a plano-convex biconvex combination. Curvature of the lens can be minimized by separating the camera and projector as much as possible.

Another critical problem in the field lens system is chromatic aberration. If the camera is located at the blue focal point, it will miss much of the red light and the picture will appear blue, and vice versa. In practice, when the image is focused on the camera lens, it appears as a white disk, surrounded by a color fringe. If the image is sufficiently large, the color fringe will not be "seen" by the camera; thus, it is important to use a large aperture projection lens and a small camera aperture to eliminate color fringing.

Notes:

1. Polarizing filters must be used on lights and camera to eliminate internal reflections in the field lens.
2. This aerial image system can be adapted to 35mm slides.

3. The cel materials used in the system are very critical. Variations in the manufacture of acetate film can cause a shadow pattern to be produced in the final picture. This pattern is apparent if a cel is moved or changed during a series of frames. Polyester cel materials are not usable since they alter the polarization of the overhead light and cause internal reflections in the field lens.
4. Additional details are contained in *Journal of the Society of Motion Picture and Television Engineers*, vol. 73, Nov. 1964, p. 956-957.
5. Inquiries concerning this innovation may be directed to:

Office of Industrial Cooperation
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439
Reference: B67-10398

Source: G. W. Tressel and S. J. Andrews, Jr.
Information Services Division
(ARG-165)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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